Systems approach for electric motor driven systems in Dutch industries

Results of the Pilot Audit program electric motor driven systems and developments of Dutch regulatory scheme for industrial energy effiency

streamSAVE dialogue group
webinar “Accelerated replacement of inefficient electric motors”

24 May 2022, via ZOOM

Maarten van Werkhoven, TPA advisors - NL
Frank Hartkamp, Netherlands Enterprise Agency - NL

Content

- Dutch energy and climate policy
- Results of Pilot audit program electric motor systems
- Revision of Dutch industrial energy efficiency regulation
- Annex analysis of electric motor driven systems

Speaker

Maarten van Werkhoven

Independent energy consultant, based in The Netherlands. Focus on energy efficiency, energy transition and sustainable production.

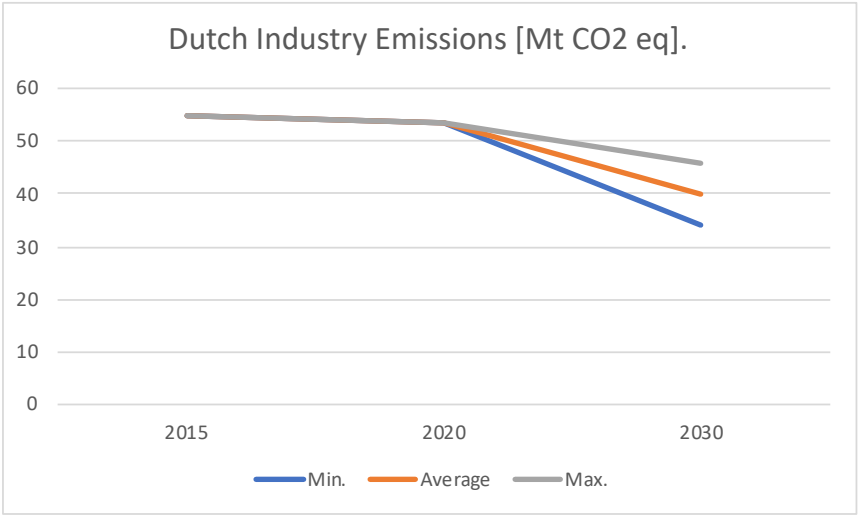
Working with the IEA Technical Cooperation Program 4E Electric Motor Systems Annex EMSA, member of the IEC ACEE, member of ISO & IEC JAG 22

Working in Efficiency and Carbon reduction programmes and projects in the Netherlands.

Dutch energy and climate policy

- Goals for energy efficiency (TJ) and emission reduction (Mt) have not been (fully) met; are intensified:
  - ✓ -55% emission reduction in 2030 (compared to 1990)
  - ✓ -95% emission reduction in 2050
- Industry, short term:
  - ✓ 2020 -> 2030: 53.5 Mton -> 40 Mton
    => **-25% in <10 years**

Energy efficiency: cost effective,
short term results in savings and economy



Source: Netherlands Climate and Energy Outlook 2021 www.pbl.nl

Pilot Audit program electric motor driven systems (EMDS)

Goal

- (support) energy savings in industry – industrial motor systems
- Accelerate the implementation of economically sound technologies

What

- Perform 30 audits on EMDS in industry
- Translate into a generic approach for Dutch industry

How

- Network-partners organise, members perform audits, financial support by Ministry of EZK (Climate)
- Planning: 2019-2021

Techniek Nederland
FEDA
Netherlands Enterprise Agency
HOLLAND POMP GROEP
NLdigital

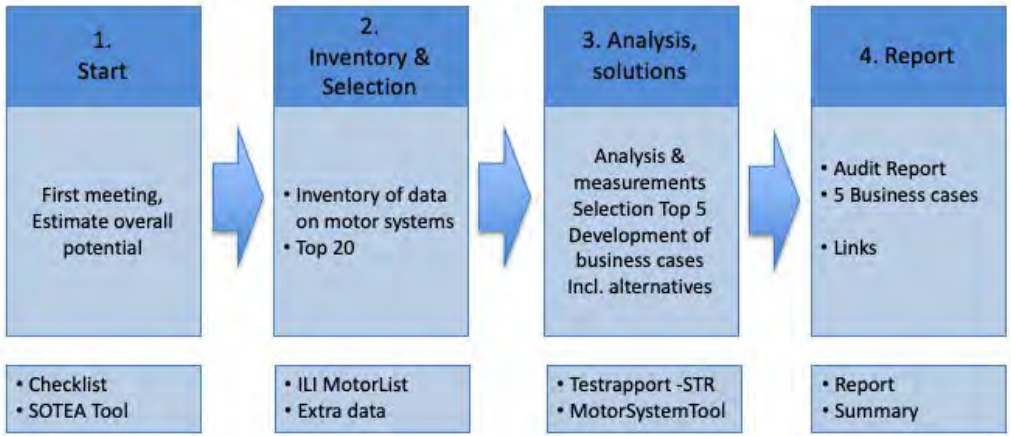
Partners Dutch Network EMDS (KEEA)

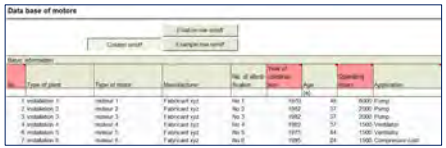
Audit - in 4 steps

With four standard steps for a systematic analysis of industrial electric motor driven systems

- Based on EMSA's 'Audit Guide EMDS' / Energy Audit standard ISO 50002
- Special tools, brand independent calculations including
  - IEC standards
  - Research data
- Standard report

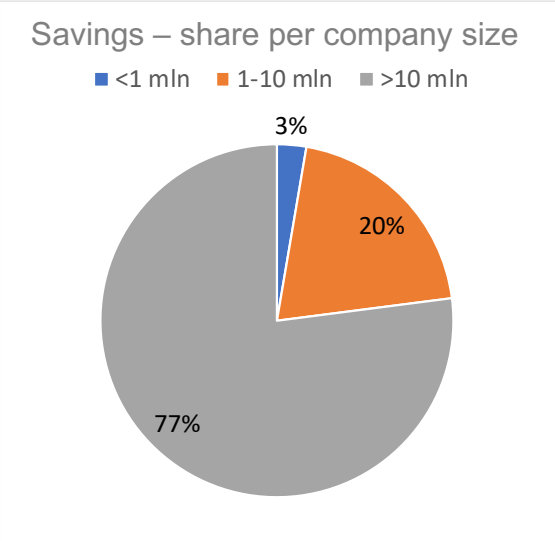
Audit steps





Audit results (1/2)

30 audits started, conducted
25 reported



Audits per sector and company's electricity use

Sector	Number audits	<1 GWh	1-10 GWh	>10 GWh
Building materials	3	2	1	
Chemical	6		1	5
Glass products	3			3
Plastic products	2			2
Logistic services	1	1		
Metal	9	2		7
Metal coatings	1		1	
Rubbers	1	1		
Packaging products	1		1	
Food	3	2	1	
Total	30	8	5	17

Audit results (2/2)

Electricity savings & economics reported, Results per sector

		Energy		Savings			Economics		Emissions
Industrial sector	Number audits #	Electricity use (in scope of audit) MWh/year	Electricity use motor systems *start-situation* MWh/year	Savings on electricity use motor systems MWh/year	savings as as share of *start* %- start e-u	Cost of energy EUR/year	Investment EUR	Simple payback time years	reduction ton CO2/yr
Food	2	1.440	1.073	156	15%	12.000	261.000	21,4	87
Chemical	5	58.496	23.575	4.283	18%	295.000	1.012.000	3,4	2.381
Metal	8	234.153	73.695	9.040	12%	483.000	1.756.000	3,6	5.026
Plastics	2	25.900	10.145	1.397	14%	76.000	274.000	3,6	777
Glass	3	146.439	88.350	8.421	10%	490.000	789.000	1,6	4.682
Other	5	6.899	5.899	837	14%	61.000	172.000	2,8	465
Total	**25**	**473.000**	**203.000**	**24.100**	**12%**	**1.417.000**	**4.264.000**	**3,0**	**13.418**

Savings 1.4 mln EUR/year --> Investment: 4.3 mln EUR, 3 year PBT

Electricity tariff (average): 5.9 EUR ct/kWh (4.3 – 11.2)

Identified measures / business cases

Renewal

- of older electric motors (av. >15 years) for highly efficient electric motors: IE4 or IE4/IE5 (SynRM – VFD-controlled)
- of the driven application, esp. pumps with correct dimensioning and fit for the correct duty point
- Improving the transmissions, e.g. reducing the number of belts in combination with adding VFD

Control, Process

- Applying speed control with a frequency controller (VFD, for variable speed control) or speed reduction with a magnetic coupling
- Applying improved control, for example with on/off control, VFD/speed control and demand control. In some cases also the correct setting of the existing control. In a few cases, certain systems could simply be turned off
- Improving the drying process through adjustments to process equipment (lowering pressures and adjusting spray-nozzle)

Monitoring: apply energy monitoring on the drives, and introducing systematic processing and use of the data through energy management system

Conclusions on Pilot Audit program EMDS

-> Imperfect market or audits on efficient electric motor driven systems
-> Good potential for energy savings on short term

Industry

- Low demand for energy efficiency solutions
  - *Limited mandate at work floor*
  - *Slow(er) progress of audit program*
- Limited data availability
  - *on energy use, assets*
  - *of (process) data, for other benefits*
- Importance of supplier independent based analyses

Audits – supply chain

- Low supply by service-companies of audits on energy efficient EMDS
  - *Limited capacity*
  - *Slow(er) execution of audits*
- In-experiences with data analysis
- Focus more on components than systems
  - *Dissolved through cooperation between suppliers*
- Cost-intensive work, not fully covered by subsidy

Next steps, regulatory focus energy efficiency

Dutch industry

- Sharpened climate targets for 2030/2050 -> update of '**energy savings obligation**'
  - Savings measures with a Simple Payback Time **below 5 years** need to implemented
  - Energy efficiency, Sustainable energy production – leading to lower emissions and energy use

- The largest industrial companies (EU ETS, NL LTA) - now exempted, will need to comply
  - Annual energy consumption of 10 million kWh electricity or 170,000 m3 natural gas (equivalent)
  - Governmental decision of Sept. 2021; will come into force per 1-12-2023
- A mandatory **energy savings analysis** (audit), 4 years cycle,
  - Analysis energy use and CO2 emissions
  - Overview of cost-effective measures plus an analysis on electric motor driven systems, and more
  - Implementation plan
  - Description of energy management system

Energy savings analysis -> reporting duty

Report energy savings analysis
• Description of activities, processes, products, installations
• Analysis of energy use and CO2 emissions
• Overview of cost-effective measures
• Overview of measures taken
• Overview of measures yet to be implemented with a payback period of no more than years (implementation plan)
• Description of structural energy management

Energy savings analysis -> reporting duty

Report energy savings analysis
• Description of activities, processes, products, installations
• Analysis of energy use and CO2 emissions
• Overview of cost-effective measures
• Overview of measures taken
• Overview of measures yet to be implemented with a payback period of no more than years (implementation plan)
• Description of structural energy management

Description of activities, processes, products, installations
Analysis of electric motor driven systems
Scan technical isolation
List of basic measures

Analysis of the electric motor driven systems

A) Company Policy Statement

- ✓ Periodic updating of data on main energy-using electric motor driven systems (in accordance with B))
- ✓ Periodic research into possibilities to improve the efficiency and energy consumption of the electric motor driven systems (in accordance with C))
- ✓ A maintenance and replacement strategy

B) Inventory of motor driven systems + specification of measures

- ✓ Electric motor and application
- ✓ From 15 kW nominal power and 3’000 operating hours per year

C) Specification of savings measures for motors and motor driven systems

Characteristics to be examined periodically	Potential measures, to be analyzed in more detail	Motor	Pump	Fan	Comp	Mach
Replacement of motor and/or application after the end of its economic life for highly efficient units;	Those older than 15 years and/or have a low efficiency (<IE3)	X				X
	Those older than 15 years and/or have a low efficiency (lower than the minimum efficiencies according to EC 547/2012)	(X)	X			
	Those older than 10-15 years and/or have a low efficiency (lower than the minimum efficiencies according to EC 327/2011)	(X)		X		
	Where the compressor(s) package is/are older than 10 years	(X)			X	
Correct control of the systems so that idle running applications are switched off and that non-functional bypasses are removed;	which are not switched (off or low) at lower (process) load or no load, which (continue to) run independently of the process demand	X	X	X	X	X
Power, frequency, flow and control are adequately adjusted to the demand; this is periodically examined;	Which have not been adapted to changed functional requirements (compared to design), causing them to run underloaded (low load, <60%)	X				X
	Ditto, so that they are operated sufficient hours around the optimal operating point /BEP (best efficiency point)		X	X	X	
Other adjustments to drive systems with better control and/or system adjustments for optimal energy use	Remove throttles, inefficient transmissions, improve internals and/or components in the drive system	X	X	X	X	X

Take aways

Energy efficiency in Dutch industry

- Industry encounters increasing pressure to act on energy efficiency, from government and energy market
- Solutions for short term implementation are available and economically sound
- Challenges into (lack of) resources, finance, trust and priority can be resolved

- Systematic analysis and implementation of energy efficiency measures in electric motor driven systems is part of the energy savings regulation in The Netherlands, for large industries

- Continuous attention is needed for capacity building in industry, energy-advisors and enforcement

Thank you

Maarten van Werkhoven, mvanwerkhoven@tpabv.nl
Frank Hartkamp, frank.hartkamp@rvo.nl

May 2022